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<b>(54) Title:</b> IMPROVED ELASTOMERIC HOT MELT PRESSURE SENSITIVE ADHESIVE COMPOSITION  <b>(57) Abstract</b> <p>An elastomeric, hot melt, pressure sensitive adhesive composition which possess superior properties for the construction of disposable soft articles. The composition includes an S-I-S block copolymer, a resin vehicle which associates with both the mid-lock and endblocks of the S-I-S block copolymer, and a processing oil.</p>		

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IMPROVED ELASTOMERIC HOT MELT  
PRESSURE SENSITIVE ADHESIVE COMPOSITION

1. Field of The Invention:

The present invention relates to improved elastomeric hot melt adhesive compositions and more particularly, to elastomeric hot melt adhesive compositions which finds utility in the construction of disposable absorbent articles such as all manner of diapers and similar articles.

2. Background of The Invention:

The prior art is replete with numerous articles which are manufactured for use in the absorption of menstrual flow, urine, fecal matter and other body exudates and discharges. For example, disposable diapers for infants, and undergarments for adults who have anomalies which render them partially or totally incontinent, are widely employed by the general public, and are commercially available nationwide. In the construction of such disposable articles, some level of attention has been directed to the manufacture of disposable articles wherein the article has improved leg cuffs which retain the body exudates within the disposable article. A disclosure of such an improved leg cuff is disclosed in U.S. Patent No. 5,032,120 to Freeland et al., and which is incorporated by reference herein.

While the prior art noted above discloses elastomeric adhesive compositions which may be combined into a laminar type construction which has elastic properties, and which further can be incorporated into various features of a disposable garment thereby rendering the article substantially form fitting, these same adhesive compositions, however, possess a multiplicity of shortcomings which have detracted from their usefulness. For example, and in the patent to Freeland et al., U.S. Patent No.

5,032,120, the inventors disclose a hot melt elastomeric adhesive composition, having a trade designation "198-338," and which is manufactured by Findley Adhesives, Inc., of Wauwatosa, Wisconsin, as being particularly well suited for the construction of the central laminar of the diaper. However, and while the adhesive composition "198-338," appears useful for the purposes described, the thin film holding strength of this same composition, that is, the elastomeric retention of the adhesive composition when elongated, rapidly decreases over time thereby reducing the usefulness of this particular adhesive composition in disposable garments. Further, this same adhesive composition possesses an unusually long recovery time, that is, the time it takes for the adhesive to retract to its original length following elongation.

Additionally, and while other elastomeric adhesive compositions and constructions employing same have been

proposed and disclosed, such as in the patents to Bunnelle et al., Patent No. 4,418,123; 4,259,220 and 4,543,099, respectively, these same formulations, from a practical standpoint, have not been widely embraced by the nonwovens industry for a number of practical reasons. For example, the elastomeric adhesive formulations disclosed in the Bunnelle et al. patents while functioning as both an adhesive and elastomeric film has, as one of its many physical characteristics, a viscosity which exceeds 1 million centipoise at 325°F. Consequently, the adhesive compositions disclosed in the Bunnelle et al. patents can only be applied by utilizing very expensive manufacturing machinery such as extruders, and the like. Further, it should be recognized that this same physical characteristic, that is, viscosity, has the effect of slowing the speed of production lines utilizing conventional manufacturing machinery thereby increasing the manufacturing costs of garments which employ the same compositions.

In addition to the foregoing, these same elastomeric adhesive compositions disclosed in the Bunnelle et al. patents are further undesirable from a manufacturing perspective inasmuch as the respective formulas, which utilize two separate resin vehicles, that is, a first resin vehicle which associates primarily with the midblock of an A-B-A block copolymer such as styrene-isoprene-styrene (S-I-S) or the like, and a second resin vehicle which associates primarily

with the endblocks of the same A-B-A copolymer do not appear to possess the level of adhesion which is necessary for the construction of disposable garments. Moreover, these formulas do not, due to their formulations, appear to provide for a convenient and expeditious means by which adhesion can be adjusted without effecting their elastomeric nature.

Therefore, it has long been known that it would be desirable to provide an improved, elastomeric, hot melt adhesive composition for use in disposable garments such as diapers and the like and which has a composition which has a desirable manufacturing viscosity and which further has a thin film holding strength and a speed of recovery which are greater than that provided by the prior art hot melt adhesive compositions utilized heretofore.

### 3. Objects and Summary of The Invention:

It is therefore an object of the present invention to provide an improved elastomeric, hot melt, pressure sensitive adhesive composition.

It is a further object of the present invention to provide an elastomeric, hot melt, pressure sensitive adhesive composition which may be made integral with a disposable soft good such as a diaper or the like, the composition, when

incorporated or made integral with the garment, rendering the garment, or portions thereof, elastomeric.

It is a further object of the present invention to provide an elastomeric, hot melt, pressure sensitive adhesive composition which may be applied in applications which include elasticizing entire panels of a disposable garment, or, alternatively, discrete areas thereof.

It is a further object of the present invention to provide an elastomeric, hot melt, pressure sensitive adhesive composition which may be formed into a sheet utilizing relatively inexpensive manufacturing techniques or devices.

It is a further object of the present invention to provide an elastomeric, hot melt, pressure sensitive adhesive composition which has the following composition:

about 15%, to about 60%, by weight, of an A-B-A block copolymer, and wherein the A block includes styrene, and the B block includes butadiene or isoprene;

about 30%, to about 70%, by weight, of an aromatic modified hydrocarbon resin which associates with both the midblock and endblocks of the A-B-A block copolymer; and

0 to about 30%, by weight, of a processing oil, and wherein the foregoing proportions are selected to provide a pressure sensitive adhesive composition having a viscosity of less than 200,000 cP at 325°F and an elastomeric retention of greater than 75%.

Still, a further object of the present invention is to provide an elastomeric, hot melt, pressure sensitive adhesive composition for the purposes described, and which is durable, easy to apply utilizing conventional hot melt adhesive manufacturing techniques, and which further does not have the numerous shortcomings attributable to the prior art adhesive compositions or elastomeric films which have been utilized for substantially identical purposes heretofore.

#### 4. Description of The Preferred Embodiment:

The preferred, elastomeric, hot melt, pressure sensitive adhesive composition of the present invention contains generally about 15% to about 60%, by weight, of an A-B-A block copolymer, and wherein the A block can be selected from the group which includes styrene; alphas-methyl styrene; vinyl toluene and the B block includes butadiene or isoprene; about 30% to about 70%, by weight, of an aromatic modified hydrocarbon resin which associates with both the midblock and the end blocks of the A-B-A block copolymer; and 0 to about 30%, by weight, of a processing oil, and wherein the foregoing



proportions are selected to provide an elastomeric pressure sensitive adhesive composition having a viscosity of less than 200,000 cP at 325°F and an elastomeric retention of greater than 75%.

As should be understood, both S-I-S and S-B-S copolymers have been found useful in the present formulations. In this regard, the S-I-S or S-B-S block copolymer component of the elastomeric, hot melt, pressure sensitive adhesive composition of the present invention may be of two specific classes:

(a) An unvulcanized elastomeric block copolymer wherein the respective monomeric moieties are arranged in an alternating sequence having the general configuration S-I-S or S-B-S. In this first class, "S" is a non-elastomeric block derived from styrene, and "I" or "B" is an elastomeric polymeric block derived from isoprene or butadiene, respectively. In the preferred embodiment, the total concentration of styrene in the block copolymer may vary in a wide range of about 15% to about 50% of the total weight of the copolymer. Additionally, it has been found to be advantageous to utilize block copolymers which are substantially 100% fully coupled. Suitable styrene-isoprene-styrene block copolymers for use herein are commercially available from the Dexco Chemical Company under the product or trade

designations Vector 4211, Vector 4411, and Vector 4111, respectively. In this regard, Vector 4211 and 4411 have respective styrene contents of about 29% and 44% of the total weight of the copolymer. Further, an S-I-S block copolymer provided by the Shell Chemical Company under the trade designation RP6407 and Vector 4111 which is provided by The Dexco Chemical Company each have a styrene content of about 17% of the total weight of the copolymer. Both polymers have been found useful in the present adhesive compositions.

(b) A teleblock copolymer including molecules having at least three branches which radially branch out from a central hub, each of the branches having polystyrene terminal blocks and an isoprene or butadiene segment in the center. This type of block copolymer may also be described as having a branched polymerized isoprene or butadiene midblock with a polystyrene terminal block at the end of each branch. The total concentration of the styrene monomer would similarly range from about 15% to 50% of the total weight of the copolymer. Similarly, this second class of copolymers would also be fully coupled, or nearly so.

It will also be recognized that mixtures of the above-identified block copolymers may also be utilized with equal success. Further, the inventors have discovered that

the polymer marketed under the trade designation "Stereon" can be utilized in the present invention. "Stereon" is manufactured by the Firestone Chemical Co.

It should be understood, however, that adjustment of the percent concentration of diblock (S-I) present in the block copolymer mixture (S-I-S), that is, providing an S-I-S block copolymer which is not 100% fully coupled, or nearly so, will produce somewhat undesirable results. In this regard, it has been discovered that a relationship exists between the force which is expressed as the elastomeric retention in the compositions of the present invention, at a given interval of time, and the coupling efficiency of the S-I-S block copolymer which is utilized with same. For example, and as will be discussed in further detail hereinafter, the inventors have discovered that by decreasing the amount of diblock present in a formulation they correspondingly increase the elastomeric retention of the composition at the same given time interval. Additionally, the inventors have discovered that decreasing the amount of diblock present in the S-I-S block copolymer additionally increases the tensile strength of the same composition.

As will become evident hereinafter, the inventors of the present invention have also discovered surprising results when they employ S-I-S block copolymers which have the characteristics noted above, but which further have a styrene

concentration in the range of about 25-50% of the total weight of the copolymer. In particular, the inventors have discovered that compositions of the present invention display particularly desirable viscosities when compared with compounds manufactured from related A-B-A copolymers which have less than 25% styrene, by weight, of the entire copolymers.

The aromatic modified hydrocarbon resin of the present invention, which associates with both the midblock and the end blocks of the styrene-isoprene-styrene block copolymer, are commercially available from the Exxon Chemical Company under the trade designation "ECR 165A and ECR 165C, respectively." Additionally, it has been discovered that styrenated terpenes, such as those materials which are marketed under the trade designation "Zonatac 105 Lite" and which are manufactured by the Arizona Chemical Company, may be substituted in place of the aromatic modified hydrocarbon resins noted above, with equal success. For purposes of this application, the term aromatic modified hydrocarbon resin, by definition, includes the group of styrenated terpenes disclosed, above.

As noted earlier, the inventors in the patents to Bunnelle et al. disclose an extrudable self-adhering elastic composition which consists generally of an A-B-A block copolymer having at least one substantially amorphous rubbery

polymeric midblock and at least two glassy poly(vinylarene) endblocks; a midblock associating resin; and an endblock associating resin having a glass transition temperature and a softening point above about 115°C each, per 100 parts of the block copolymer. The proportions of the constituent elements of the Bunnelle et al. compositions were selected to provide a very specific range of properties including specific tensile strengths, peel resistance, deadload deformations, and loss modulus.

Similarly, the adhesive composition identified in the reference to Freeland et al. as "198-338," as a general matter, includes an A-B-A block copolymer; a midblock associating resin; an endblock associating resin; a processing oil; and an antioxidant/stabilizer.

As will become evident, hereinafter, the inventors have discovered surprising performance characteristics when they employ the elastomeric, hot melt, pressure sensitive adhesive compositions of the present invention. In particular, and as compared with the performance characteristics of the prior art compositions noted above, which are the closest prior art known to the inventors, it was discovered that the present compositions have an unusually desirable viscosity, from a manufacturing standpoint, and further, have an elastomeric retention value which is greater than 75%. Additionally, the present compositions have a speed

of recovery, following elongation, which was nearly two-fold, faster than the same values attributable to the prior art compositions noted above.

Various plasticizing or processing oils are also present in the compositions of the present invention in amounts of about 0%, to about 30%, by weight, in order to provide some level of viscosity control and further to operate as a diluent. In the preferred formulation, the inventors have discovered that paraffinic or naphthenic white processing oils operate quite well in the present formulations. A commercially available white processing oil can be secured from the Witco Chemical Company as "Witco Plastics Oil 380." Additionally, a suitable oil may be purchased under the trade designation "Kaydol."

The antioxidants/stabilizers which are used in the elastomeric, hot melt, pressure sensitive adhesive compositions of the present invention are incorporated to help protect the otherwise vulnerable S-I-S or S-B-S block copolymer, and thereby the total adhesive composition, from the deleterious thermal and oxidative effects which are frequently experienced by other similar copolymers during the manufacture and application of adhesive compositions utilizing same, as well as in the ordinary use of the final manufactured product. As should be understood, such degradation usually manifests itself by the deterioration of the adhesive

composition in appearance, physical properties and performance. Among the most useful stabilizers are the high molecular weight hindered phenols and multi-functional phenols, such as sulfur and phosphorous-containing phenols. In this regard, hindered phenols are well-known to those skilled in the art and may be purchased commercially under the trade designation "Irganox 1010" from the Ciba-Geigy Company. Other useful antioxidants and stabilizers include "Cyanox LTDP", and which is manufactured by American Cyanamid, and "Mark 273" which is manufactured by the Witco Chemical Company. The performance of these stabilizers may be further enhanced by utilizing in conjunction therewith; (1) synergists such as, for example, thiodipropionate esters and phosphites; and (2) chelating agents and metal deactivators as, for example, ethylenediaminetetraacetic acid, salts thereof and disalicylapropylenediimine.

The composition of the present invention may be formulated using any of the techniques known in the art. A representative example of the prior art procedure involves placing all of the oil and stabilizer substances in a jacketed mixing kettle, and preferably in a jacketed heavy duty mixer of the Baker-Perkins or Day type and which is equipped with rotors, and thereafter, raising the temperature of this mixture to about 250°F to 350°F. As should be understood, the precise temperature to be used in this step will depend on the melt point of the particular ingredients. When the initial

mixture noted above, has been heated, the mixture is blanketed in CO<sub>2</sub> at a slow flow rate and the resins described above are slowly added. When the resins are melted, and at the desired temperature, the S-I-S block copolymer is added to the mixture. The resultant adhesive composition mixture is agitated thereafter until the S-I-S block copolymer is completely dissolved. A vacuum is then applied to remove any entrapped air.

Examples of elastomeric, hot melt, pressure sensitive adhesive compositions of the present invention were made by the general procedure, noted above. The formulations are set forth below.

Example 1

45%, by weight, of an S-I-S block copolymer;  
(Vector 4111; Dexco Chemical Company 17% styrene)

40%, by weight, of an aromatic modified  
hydrocarbon resin; ("ECR 165A"; Exxon Chemical Company)

15%, by weight, of a paraffinic/napthenic white  
processing oil ("Kaydol"; Witco Chemical Company)

0.5%, by weight, of a stabilizing antioxidant;  
("Mark 273"; Witco Chemical Company)



0.25%, by weight, of a hindered phenol antioxidant; ("Irganox 1010"; Ciba-Geigy Corporation); and

0.25%, by weight, of a DLTPD antioxidant synergist ("Cyanox LTDP"; American Cyanamid Corporation).

Example 2

45%, by weight, of an S-I-S block copolymer, ("Vector 4211"; Dexco Chemical Company; 29% styrene)

40%, by weight, of an aromatic modified hydrocarbon resin; ("ECR 165C"; Exxon Chemical Co.)

15%, by weight, of a paraffinic/naphthenic processing oil ("Kaydol"; Witco Chemical Company)

.25%, by weight, of a hindered phenol antioxidant; ("Irganox 1010"; Ciba-Geigy Corporation)

.25%, by weight, DLTPD; and ("Cyanox LTDP"; American Cyanamid Corporation)

.50%, by weight, of a compatible stabilizer. ("Mark 273"; Witco Chemical Company)

Example 3

45%, by weight, of an S-I-S block copolymer  
("Vector 4411"; Dexco Chemical Company; 44% styrene)

40%, by weight of an aromatic modified  
hydrocarbon resin; ("Zonatac 105 Lite"; Arizona Chemical  
Company)

15%, by weight of a processing oil; ("Kaydol";  
Witco Chemical Company)

.25%, by weight, of a hindered phenol  
antioxidant; ("Irganox 1010"; Ciba-Geigy Corporation)

.25%, by weight, of DLTDPP; and ("Cyanox LTDP";  
American Cyanamid Corporation)

.50%, by weight, of a compatible stabilizer  
("Mark 273"; Witco Chemical Company)

Example 4

45%, by weight, of an S-I-S block copolymer;  
("Vector 4211"; Dexco Chemical Company; 29% Styrene)

40%, by weight, of an aromatic modified hydrocarbon resin; ("Zonotac 105 Lite"; Arizona Chemical Company)

15%, by weight, of a paraffinic/napthenic processing oil; ("Kaydol"; Witco Chemical Company)

.25%, by weight of a hindered phenol antioxidant; ("Irganox 1010"; Ciba Geigy Corporation)

.25%, by weight, of DLTDP; and ("Cyanox LTDP; American Cyanamid Corporation);

#### Example 5

45%, by weight, of an S-I-S block copolymer; ("Vector 4211"; Dexco Chemical Company; 29% Styrene)

40%, by weight, of an aromatic modified hydrocarbon resin; ("ECR165C"; Exxon Chemical Company)

15%, by weight, of a paraffinic/napthenic processing oil; (Witco Plastics Oil 380; Witco Chemical Company)

.25%, by weight, of a hindered phenol antioxidant; ("Irganox 1010"; Ciba-Geigy Corporation)

.25%, by weight, of DLTDP; and ("Cyanox LTDP"; American Cyanamic Corporation)

.50%, by weight, of a compatible stabilizer (Mark 273; Witco Chemical Company)

The resulting elastomeric, hot melt, pressure sensitive adhesive compositions, upon testing, were found useful for the construction of soft goods. Additionally, it was discovered, that these same compositions could be foamed successfully contrary to the prior art substances, noted above, and which are disclosed in the patents to Bunnelle et al., and which cannot be foamed due to their exceedingly high viscosities.

Following the formulation of the adhesive compositions, noted above, the following tests were performed.

Viscosity: This characteristic was measured by employing conventional technology. In this regard, the viscosity of the compositions were measured at a temperature of 325°F and is expressed in Centipoise (cP). A Brookfield Thermosel was utilized to determine the viscosity. The viscosity measurement was done in accordance with ASTM Method D3236-73.

Elastomeric Retention: This test was the measure of the force of recovery exerted or exhibited by a sample of the composition following its elongation during a predetermined interval of time. In this regard, samples of the composition, noted above, were coated on an Acumeter LH1 coater. The coating of the composition was approximately 5 mils thick and approximately 1.5 inches (38.1 mm) wide. The carrier substrate for the coating included a double-sided release paper. The samples to be tested were rewound onto themselves. Following a period of storage for 24 hours, the samples to be tested were cut, in the machine direction, to become a size of approximately 1 inch (25.4 mm) thereby eliminating any flaws in the samples which could exist along the edges of same. Samples were then cut to the appropriate length and placed in an Instron Series IX Tensile Tester. Each sample to be tested was then elongated or pulled to a distance which represented an elongation equal to 40%, and in a second series of tests, 80% of its unstressed length, at a rate of 20 inches per minute (50.8 cm/min.). The samples were held at these distances for a period of thirty (30) seconds. Following this first holding period, the force of elongation was removed, thereby permitting the individual samples to return or retract to their original length. The period of rest was 1 minute. Following the period of rest, the force of elongation was again applied for a second

holding period to extend the sample to the same distance at the same rate of speed, (50.8 cm/min). Measurements of the elastomeric recovery force which were exhibited by the samples were then taken at the beginning of the test; at the beginning of the first holding period; at the end of the second holding period; and at the end of the second cycle. The percent elastomeric retention is calculated by forming a fraction which has, as its numerator, the force exerted by the sample at the end of the second holding period; and as its denominator, the force exerted at the beginning of the first holding period. This fraction is then multiplied by 100 to provide a product which equals the percent of elastomeric retention. The samples were then compared and contrasted with the closest prior art known to exist, that is, the elastomeric materials disclosed in Freeland et al., Patent No. 5,032,120, and Bunnelle et al., Patent Nos. 4,418,123, 4,259,220, and 4,543,099. The results are set forth below:

Sample:

1. Example 1 employing 100% coupled S-I-S copolymer - -  
84.19% retention.
2. Example 2 employing 100% coupled S-I-S copolymer - -  
89.7% retention.

3. Example 3 employing 100% coupled S-I-S copolymer - - 84.7% retention.
4. Example 4 employing 100% coupled S-I-S copolymer - - 93.3% retention.
5. Example 5 employing 100% coupled S-I-S copolymer - - 90.5% retention.
6. "198-338" Findley Adhesives, Inc., Wauwatosa, Wisconsin (Freeland et al., Patent No. 5,032,120;) employing 80% coupled S-I-S copolymer - - 44.76% retention.
7. Elastomeric materials made in accordance with the teachings of Bunnelle et al. - - 68.47% retention.

The samples, above, had the following viscosity:

1. Example 1 @ 325°F. 34,000 cP.
2. Example 2 @ 325°F. 23,300 cP.
3. Example 3 @ 325°F. 11,125 cP.
4. Example 4 @ 325°F. 21,000 cP.
5. Example 5 @ 325°F. 25,250 cP.
6. 198-338 @ 325°F. 77,000 cP.
7. Bunnelle et al. greater than 1 million cP at 325°F.

Tensile Strength:

As noted earlier, the inventors have discovered that the use of S-I-S block copolymers which have increasing amounts of diblock, that is, utilizing polymers which are not 100% fully coupled, has deleterious consequences vis-a-vis the tensile strength of the composition and the amount of recovery experienced by the composition, for a given time, following elongation. To demonstrate this effect, samples of the present composition were formulated in accordance with the teachings noted above, and were formed into 1 inch width (25.4 mm), and 5 mil thick pieces. These individual pieces were then placed in the same Instron machine, noted earlier, and were elongated or pulled to a distance which represented an elongation equal to 40% and latter tests, 80% of its unstressed length, for a period of 30 seconds, relaxed for 60 seconds, and then exposed to the same stress for 30 seconds. Data relative to the force of recovery of the individual samples were collected at the beginning of each pull, and just prior to the end of each of the 30 second holding cycles. The maximum tensile strength was then measured at the beginning of the first cycle and the percent recovery is calculated as follows:

$$\frac{\text{Tensile strength following the second 30 sec. holding cycle}}{\text{Tensile Maximum}} \times 100 = \% \text{ recovery}$$



The results are as follows:

Percent Coupled S-I-S	Percent Recovery	Tensile Maximum
100%	78%	32 grams
90%	73%	27 grams
80%	73%	26 grams
70%	67%	24 grams
60%	64%	21 grams

Samples 1-5 further had a tensile strength of at least 5 psi at 40% elongation at 25°C.

The results of the test, noted above, reveals that as the amount of diblock increased relative to the total concentration of the block copolymer the amount of recovery, as well as tensile strength decreased. Thus, a decrease in coupling efficiency effects the present compositions recovery performance and tensile strength in nearly direct proportion to the amount of diblock which is present.

Rate of Recovery:

To measure the rate of recovery of the compositions of the present invention and contrast them with the most relevant prior art known to the inventors, the inventors performed a first rheometric test by employing a Rheometer marketed under the trade designation RDA 700 by Rheometrics, Inc. The inventors employed the instrument in a stress relaxation test mode. In this test, the sample to be tested

is positioned between opposing plates and one of the plates is rotated 180° relative to the other, stationary plate. This rotation represents a 50% rotation deformation of the sample. The force of rotation is then released and the residual energy of the recovering sample is then measured, each second, for a 60 second period. In this particular test, a fully recovered sample was arbitrarily given a  $.01 \times 10^5$  dynes/cm<sup>2</sup> per second or less recovery rate. The time that it took to realize a fully relaxed sample following deformation are noted below:

1. Examples 1, 2, 4 and 5 - - 11 seconds
2. Example 3 - - less than 1 second
3. 198-338, Findley Adhesives, Inc. - - 31 seconds
4. Compositions manufactured in accordance with the teachings of Bunnelle et al. - - 32 seconds

In the next test, the inventors prepared uniform samples of the compositions of the present invention disclosed in Examples 1-5, above, and that found in the patents of Bunnelle et al. and Freeman et al. As noted, above, the present test method involved placing an initial force on each of the samples, thereby rotatingly deforming the samples by 50%. For calculation purposes, a base line stress was taken following a period of 60 seconds of relaxation. Any stress remaining in the samples following this 60 second recovery period was considered negligible. The amount of force or residual energy remaining in the individual samples following this deformation was then collected during each second, for a

period of 60 seconds. Thereafter, the total energy storage of each of the samples was calculated using the formula, below:

$$\frac{\text{dynes/cm}^2}{\text{second}} \times 60 \text{ seconds} = \text{residual energy exhibited during the 60 second test}$$

Assuming a perfectly elastic sample, the amount of residual energy remaining in a sample following the release of the deformation force would be zero. It should be understood, therefore, that as the residual energy values for each of the samples near zero, the elastic recovery properties of the samples improves. After 60 seconds of relaxation, the total system energy for each of the samples noted below were calculated:

RESIDUAL ENERGY EXHIBITED DURING 60 SECOND TEST

1. Example 1 - - - - 5.924 x 10<sup>5</sup> dynes/cm<sup>2</sup>
2. Example 2 - - - - 4.591 x 10<sup>5</sup> dynes/cm<sup>2</sup>
3. Example 3 - - - - .01 x 10<sup>5</sup> dynes/cm<sup>2</sup>
4. Example 4 - - - - 4.809 x 10<sup>5</sup> dynes/cm<sup>2</sup>
5. Example 5 - - - - 4.804 x 10<sup>5</sup> dynes/cm<sup>2</sup>

Freeman et al. - - - - 15.340 x 10<sup>5</sup> dynes/cm<sub>2</sub>  
Patent No. 5,032,120  
"198-338" Findley  
Adhesives, Inc.

Bunnelle et al. - - - - 18.534 x 10<sup>5</sup> dynes/cm<sup>2</sup>  
Patent Nos.  
4,259,220; 4,418,123  
and 4,543,099

As is evident upon reviewing the data, above, the adhesive compositions of the present invention have residual energy values which demonstrate that they are individually far superior elastomeric substance than those of the prior art. Furthermore, the test data demonstrates that the substances of the prior art have a noteworthy speed of recovery when compared against the prior art.

In summary, therefore, it will be seen from the information presented, above, that the elastomeric, hot melt, pressure sensitive adhesive compositions of the present invention provides a fully dependable and practical means by which discrete portions, or entire panels of a disposable

garment can be readily elasticized while simultaneously avoiding the various detriments associated with the prior art practices for accomplishing same, which includes, among others, employing adhesives, or other elastomeric films or substances which have viscosities which are generally in excess of one million centipoise, and further utilizing elastomeric or adhesive compositions which have elastomeric retention values which make them individually unsuitable for the purpose of elasticizing entire areas of selected disposable garments. In addition to the foregoing, the improved compositions of the present invention demonstrate unusually desirable viscosities when compared with the prior art and further have elastomeric characteristics, following elongation, which are very desirable relative to the prior art compositions which have been employed for substantially identical purposes, heretofore.

It should be apparent to those skilled in the art that the foregoing examples have been made for the purposes of illustration and that variations may be made in proportions, procedures, and materials without departing from the scope of the present invention. Therefore, it is intended that this invention not be limited, except by way of the claims which follow:

Having described our invention, what we claim as new and desire to secure by letters patent of the United States is:

1. A hot melt, pressure sensitive adhesive composition having elastomeric properties, the pressure sensitive adhesive consisting essentially of:

about 15% to about 60%, by weight, of an A-B-A block copolymer, and wherein the A block includes styrene, and the B block includes butadiene or isoprene;

about 30% to about 70%, by weight, of an aromatic modified hydrocarbon resin which associates with both the midblock and the endblocks of the A-B-A block copolymer; and

0 to about 30%, by weight, of a processing oil, and wherein the foregoing proportions are selected to provide an elastomeric pressure sensitive adhesive composition having a viscosity of less than 200,000 cP and an elastomeric retention of greater than 75%.

2. A hot melt, pressure sensitive adhesive composition as claimed in claim 1 and wherein the A-B-A block copolymer includes an S-I-S block copolymer which is

substantially fully coupled, and which has a styrene content of about 25-50% of the total weight of the entire block copolymer.

3. A hot melt, pressure sensitive adhesive composition as claimed in claim 2, and wherein the pressure sensitive adhesive composition further includes about 0 to about 1%, by weight, of an antioxidant/stabilizer.

4. A hot melt, pressure sensitive adhesive composition as claimed in claim 3, and wherein the aromatic modified hydrocarbon resin is a single resin vehicle which is selected from the group which further comprises aromatic petroleum hydrocarbon resins including modified, and hydrogenated versions thereof.

5. A hot melt, pressure sensitive adhesive composition as claimed in claim 1, and wherein the pressure sensitive adhesive composition has a tensile strength of at least 5 psi at 40% elongation at 25°C.

6. A hot melt, pressure sensitive adhesive composition having elastomeric properties, the pressure sensitive adhesive consisting essentially of:

about 45%, by weight, of a styrene-isoprene-styrene block copolymer;

about 40%, by weight, of an aromatic modified hydrocarbon resin which associates with both the midblock and the endblocks of the styrene-isoprene-styrene copolymer;

about 14%, by weight, of a compatible processing oil; and

about 1%, by weight, of an antioxidant/stabilizer, and wherein the foregoing proportions provide a hot melt, pressure sensitive adhesive composition having a viscosity of less than 200,000 cP at 325°F and a tensile strength of at least 5 psi at 40% elongation at 25°C.



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US93/06614

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(S) :C09J 109/06, 125/10; C08L 53/02

US CL :525/98

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 525/98, 314, 95

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,E --- Y,E	US, A, 5,242,984, (DILLMAN) 07 SEPTEMBER 1993 column 2, lines 20-27; column 3, line 60 to column 5, line 5; Table 1, column 6, line 35-45.	1-6 ---- 1-6
X,P --- Y,P	US, A, 5,149,741 (ALPER) 22 SEPTEMBER 1992 column 4, lines 1-29; column 5, lines 19-50; column 6, lines 25-38; column 7, lines 1-68; column 8, line 35 to column 9, line 18; Table II, columns 15-16; Claims, column 18, lines 7-45.	1-6 ---- 1-6
X,P ---- Y,P	US, A, 5,143,968 (DIEHL) 01 SEPTEMBER 1992 column 2, lines 40-52; column 2, line 62 to column 4, line 62; Table, column 9-10, lines 13-47.	1-5 ---- 1-6

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be part of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Z" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

20 OCTOBER 1993

Date of mailing of the international search report

26 NOV 1993

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## INTERNATIONAL SEARCH REPORT

 International application No.  
 PCT/US93/06614

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US, A, 5,118,762 (CHIN) 02 JUNE 1992 column 2, lines 59-44; column 5, lines 3-50; column 6, line 15 to column 7, line 8.	1-6 --- 1-6
X -- Y	US, A, 4,712,808 (BEH-FORREST) 15 DECEMBER 1987 column 2, lines 7-35; column 3, lines 13-68; column 4, lines 1-6, 23-44.	1-6 ---- 1-6
X -- Y	US, A, 4,526,577 (SCHMIDT, JR.) 02 JULY 1985 column 2, lines 12-68; column 3, lines 29-68; column 4, lines 7-22, 39-60; Example 1, column 6, lines 34-68.	1-6 ---- 1-6
Y,P	US, A, 5,210,147 (SOUTHWICK) 11 MAY 1993 column 2, lines 20-25; column 3, lines 35-46; column 4, lines 5-68; column 5, lines 24-28.	1-6 ---- 1-6
Y,P	US, A, 5,169,890 (EADARA) 08 DECEMBER 1992 column 1, line 59 to column 2, line 68; column 5, lines 3-63.	1-6
Y	US, A, 5,112,889 (MILLER) 12 MAY 1992 column 4, lines 31- 64; column 6, line 8 to column 7, line 29; column 7, line 58 to column 8, line 24; column 8, lines 28-32.	1-6
Y -- A	US, A, 5,066,728 (AUDETT) 19 NOVEMBER 1991 column 4, lines 21-49.	1-6 ---- 1-6
Y	US, A, 4,699,938 (MINAMIZAKI) 13 OCTOBER 1987 column 2, line 49 to column 3, line 6; column 3, line 19 to column 4, line 17; column 5, lines 28-54; column 6, lines 5-18.	1-6
Y	US, A, 3,239,478 (HARLAN, JR.) 08 MARCH 1966 column 2, lines 1-33; column 3, lines 48-68; column 4, lines 1-42; column 5, lines 10-28, lines 60-75; column 6, line 63 to column 7, line 2; Table, column 8, line 3-20.	1-6

## B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

APS: U.S. Patents

13 S (ECR 156A OR ECR 165C OR ZONATAC 105 LITE)  
0 S L1 AND 525/98/CCLS  
2 S L1 AND 525/88,95, 98,314/CCLST  
13 S L1 NOT L2  
577 S ((MODIF### OR STYREN###) (4A) (###TERPENE)  
841827 S (ABA OR SBS OR SIS OR SEBS OR SEPS OR A-B-A OR S-B-A OR S- I-S OR S-EB-S OR S-EP-S)  
154483 S (ADHESIVE#)  
492 S L5 AND L6  
492 S L8 AND L6  
12 S (( ESCOREZ) (P) (EXXON) (P) (ECR)  
0 S ((EXXON OR ESCOREZ) (P) (ECR) (2W) (165##))  
2 S ((ECR) (4A) (165##))  
19 S L9 AND (525/88,93,95,98,314/CCLST)  
18 S L13 NOT L4